Nervous System and Brain structures

Drugs And Behavior (Binghamton University)

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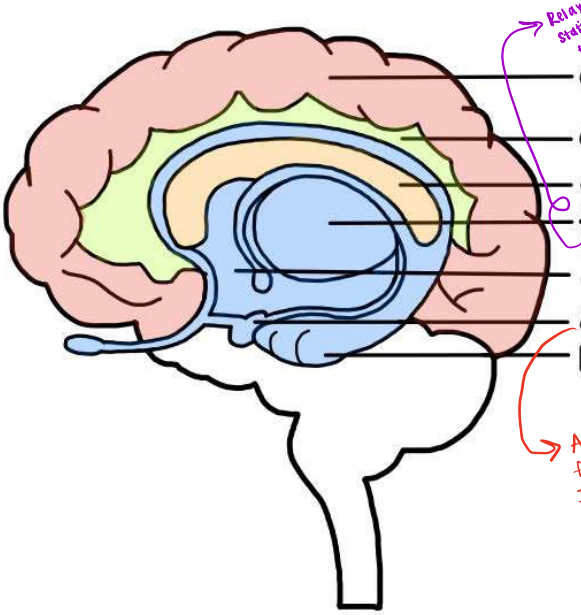
FOREBRAIN STRUCTURES



- Relay Station for rest of brain
- cerebral cortex
- cingulategyrus
- corpus callosum
- thalamus
- hypothalamus
- amygdala
- hippocampus

limbic system

Critical for motivation of behavior - involved in drinking, tempt., aggression, sexual behavior

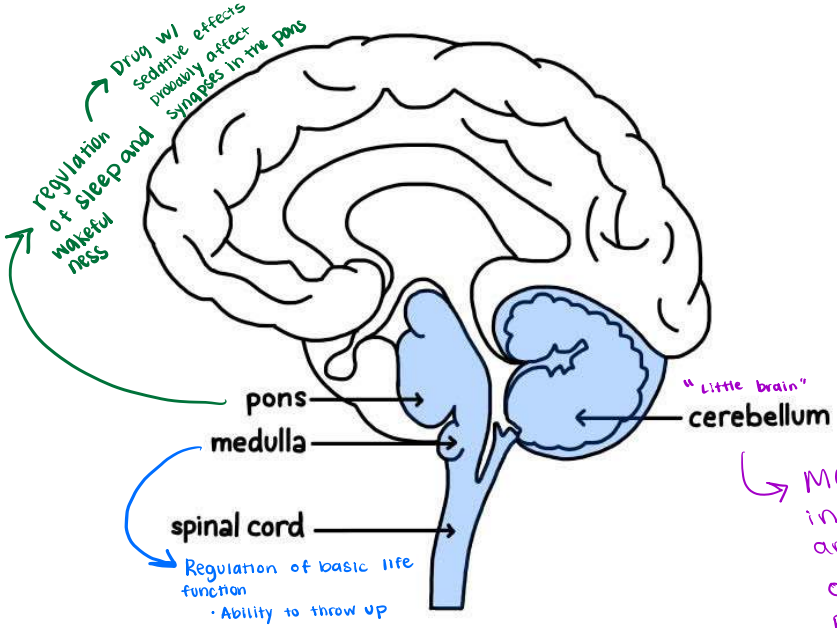
Aggression / Emotion
fight or flight
Involvment in negative emotional response
Anxiety

Memory
Ram shaped structure

Fore brain structure

Memories are linked to Emotionality

HINDBRAIN STRUCTURES

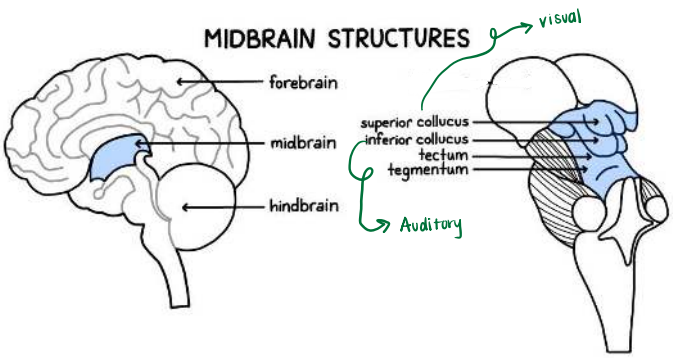


- Drug w/ sedative effects primarily affect synapses in the pons
- regulation of sleep and wakefulness
- pons
- medulla
- spinal cord
- "Little brain"
- cerebellum

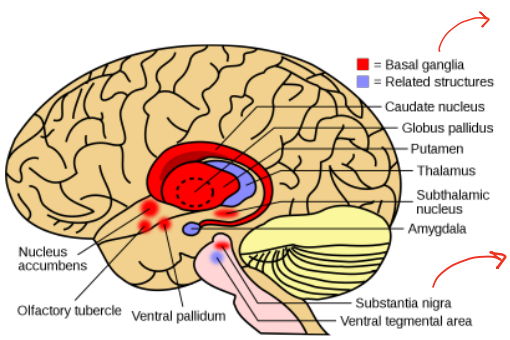
Regulation of basic life function
- Ability to throw up

Motor control involved in speech and other types of responses
Balance and coordination

MIDBRAIN STRUCTURES



- forebrain
- midbrain
- hindbrain
- visual
- superior collucus
- inferior collucus
- tectum
- tegmentum
- Auditory



- = Basal ganglia
- = Related structures
- Caudate nucleus
- Globus pallidus
- Putamen
- Thalamus
- Subthalamic nucleus
- Amygdala
- Nucleus accumbens
- Olfactory tubercle
- Ventral pallidum
- Substantia nigra
- Ventral tegmental area

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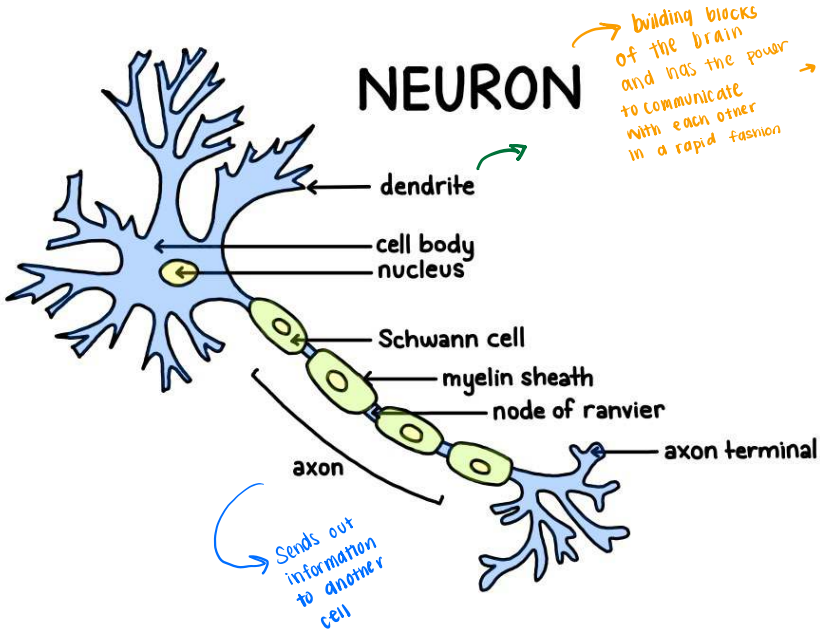

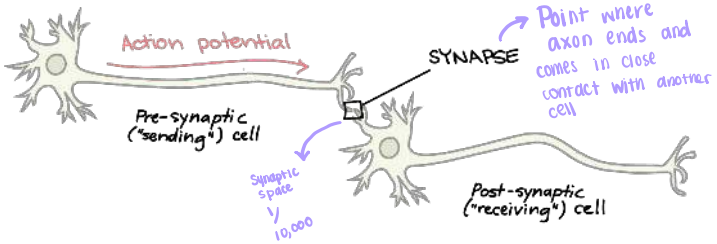

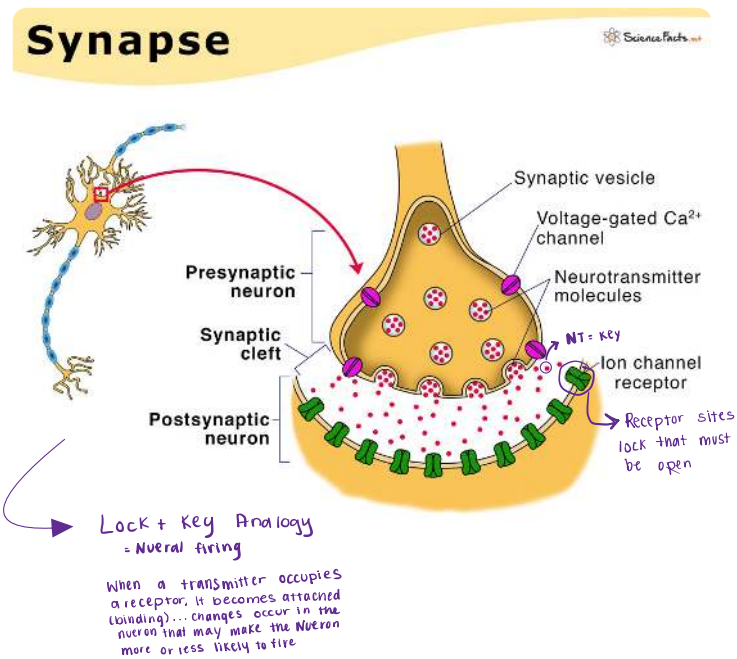
Synapse
ScienceFacts.net
Synaptic vesicle
Voltage-gated Ca2+ channel
Neurotransmitter molecules
Presynaptic neuron
Synaptic cleft
NT = key
Ion channel receptor
Postsynaptic neuron
Receptor sites lock that must be open
Lock + Key Analogy
= Nueral firing
When a transmitter occupies a receptor, it becomes attached (binding)... changes occur in the nueron that may make the Nueron more or less likely to fire

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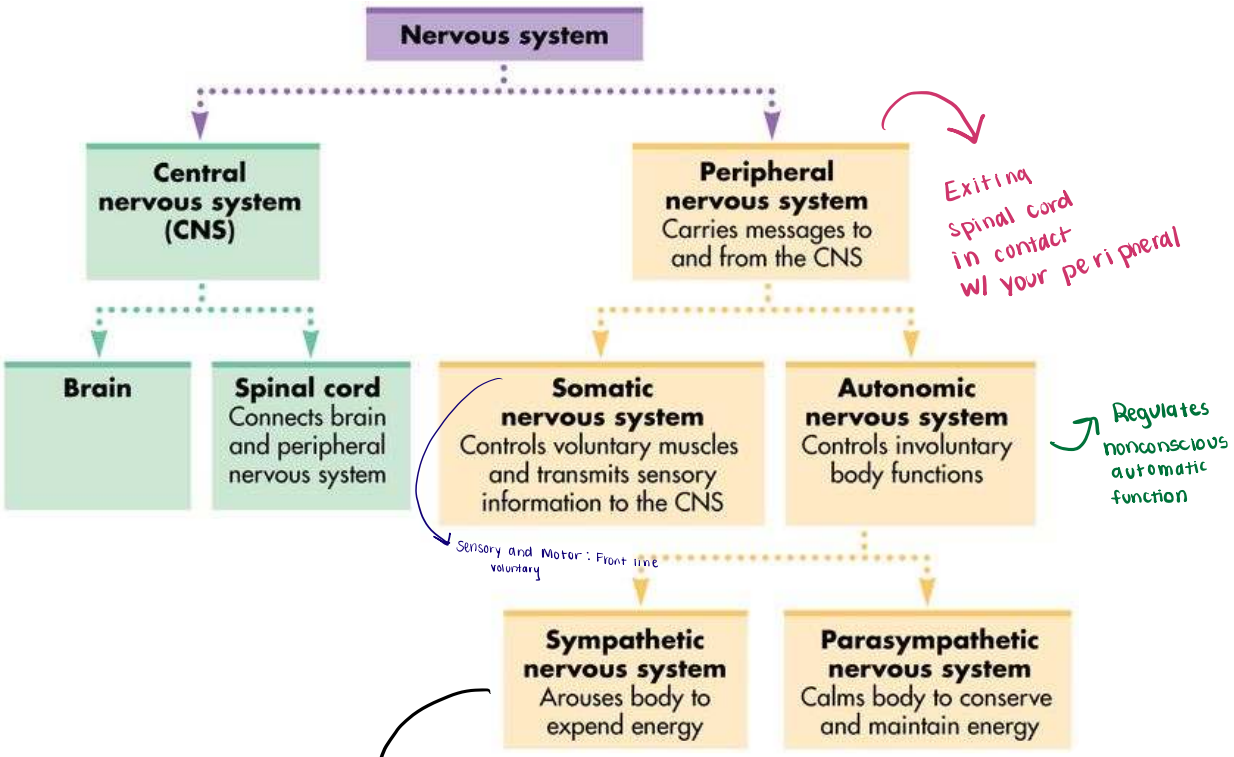
Nervous system
Central nervous system (CNS)
Peripheral nervous system
Carries messages to and from the CNS
Brain
Spinal cord
Connects brain and peripheral nervous system
Somatic nervous system
Controls voluntary muscles and transmits sensory information to the CNS
Autonomic nervous system
Controls involuntary body functions
Sympathetic nervous system
Arouses body to expend energy
Parasympathetic nervous system
Calms body to conserve and maintain energy

Exiting spinal cord in contact w/ your peripheral

Regulates nonconscious automatic function

Sensory and Motor : Front line voluntary

Readies bodies for activity, use of energy

Fight or Flight

Associated w/ a response to stress or excitation

- **Epinephrine**
- **Norepinephrine**

- Increase heart rate
- Blood pressure
- Perspiration
- Change in Dilation

↳ Readies body for restoration for energy

Normal Functions

- Acetycholine

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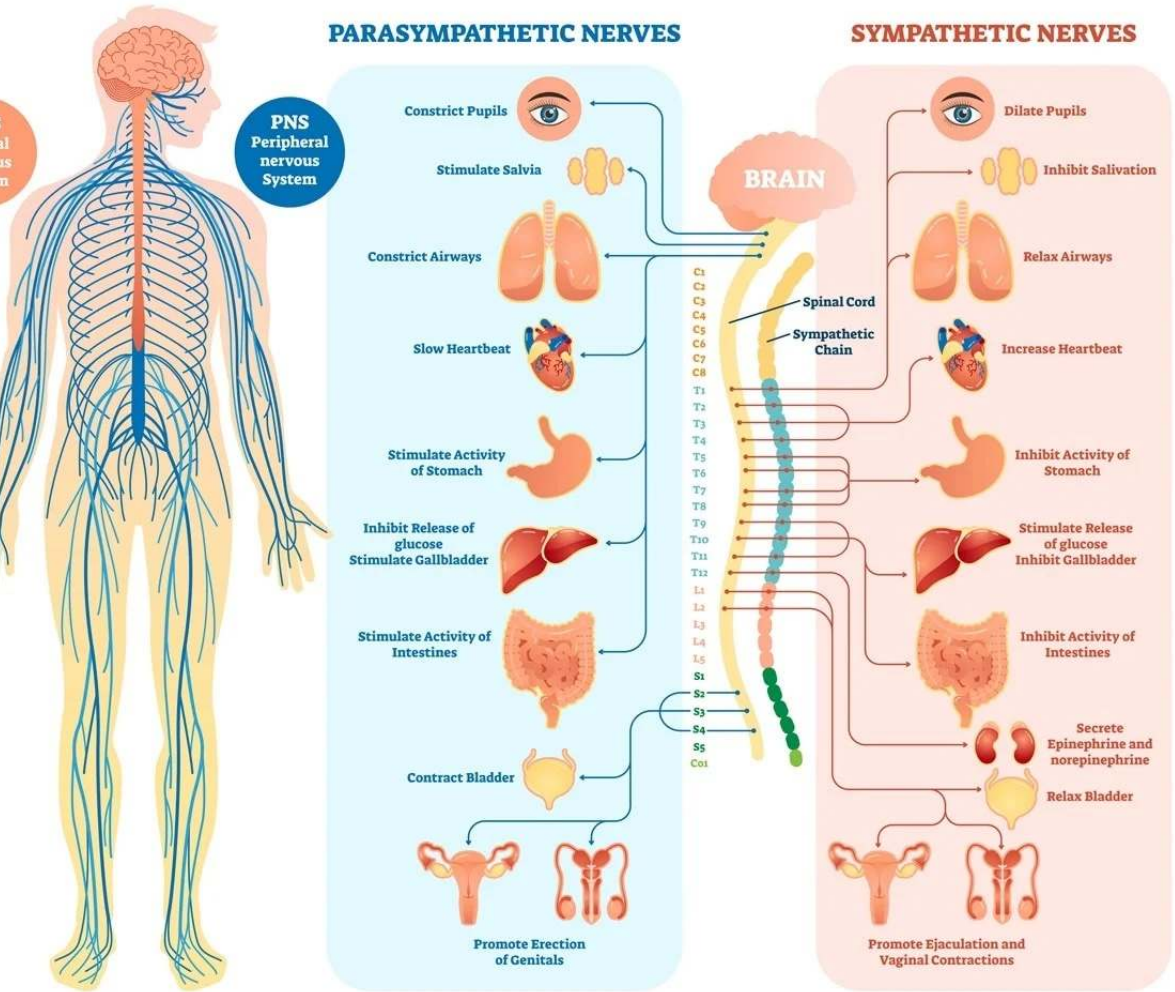
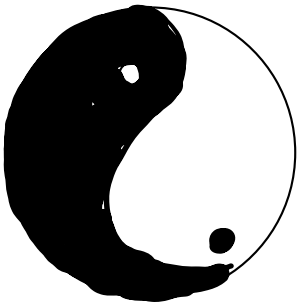
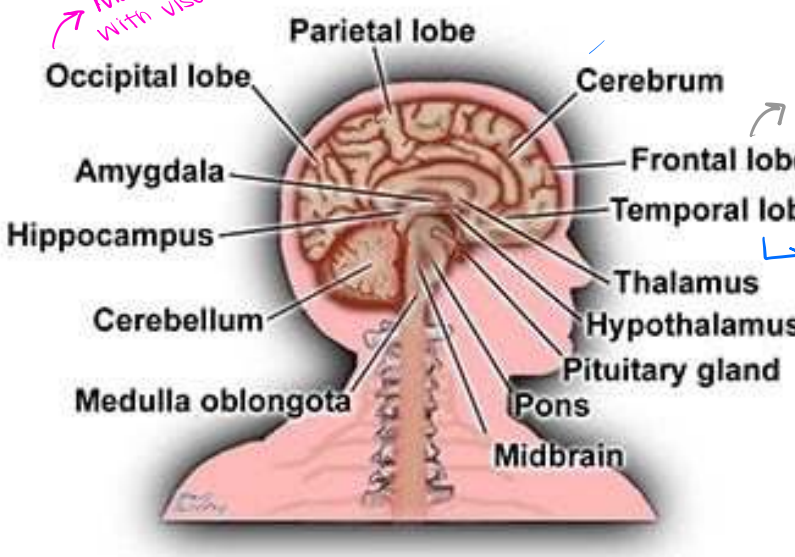
HUMAN NERVOUS SYSTEM





↳ Ying + Yang Relationship



↗ Mainly associated with visual representation

↗ Sensory processing

↗ Involved w/ emotions
Regulation with emotions
→ The last part to develop in the brain

↳ Auditory interpertation + languge

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NEUROTRANSMITTERS

ADRENALINE
fight or flight
produced in stressful situations. Increases heart rate and blood flow, leading to physical boost and heightened awareness.

GABA
calming
Calms firing nerves in the central nervous system. High levels improve focus, low levels cause anxiety. Also contributes to motor control and vision.

NORADRENALINE
concentration
affects attention and responding actions in the brain. Contracts blood vessels, increasing blood flow.

ACETYLCHOLINE
learning
Involved in thought, learning and memory. Activates muscle action in the body. Also associated with attention and awakening.

DOPAMINE
pleasure
feelings of pleasure, also addiction, movement and motivation. People repeat behaviors that lead to dopamine release.

GLUTAMATE
memory
Most common neurotransmitter. Involved in learning and memory, regulates development and creation of nerve contacts.

SEROTONIN
mood
contributes to well-being and happiness. Helps sleep cycle and digestive system regulation. Affected by exercise and light exposure.

ENDORPHINS
euphoria
Released during exercise, excitement and sex, producing well-being and euphoria, reducing pain

Gaba

- Amino Acid NT
- Most abundant in brain tissue
- inhibitory NT
- Opens negatively charged chloride ion channels that do not cause the the Nueron to fire but rather hyperpolarize the membrane and impede nueral firing

Agonist: Barbiturates
Antagonist: Bicuiline

Acetylcholine

- First NT discovered
- Acetylcholine resides in axon terminals of Nuerons that activate the skeletal muscle
- Botulinum toxin (blocks release of ACE) → Botox
- important in Memory, attention, + sensory processing
- Alzheimers disease = related to the loss of nueral funcn

Serotonin
- Monoamines (chemical structure contains a single amine group)
- involved w/ sleep + mood
- Agonist → LSD
- Antagonist → Chlorpromazine
- Some Antidepressant drugs alter brain levels of NT norepinephrine, dopamine, and serotonin by inhibiting the activity of monoamine oxidase the enzyme that breaks down the compound

Norepinepherene
- mediates emotional arousal. Attentiveness
- Initiation of Eating
- involved w/ sympathetic branch of autonomic NS

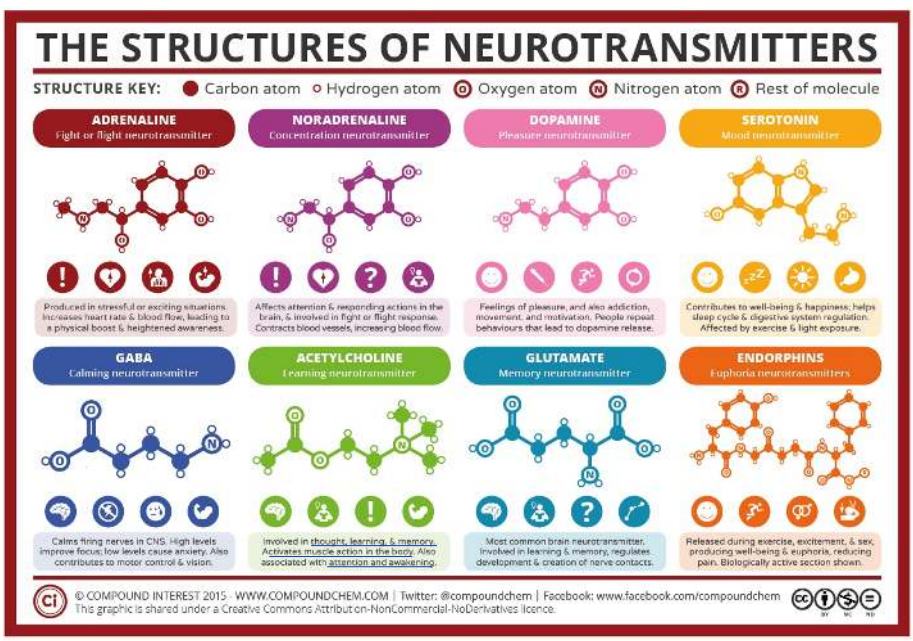
Dopamine
involved with movement + reward regulated coordinated motor movements
Dopamine insufficency → Parkinsons disease
L- dopa → correct dopamine difficency
- Substania nigra produces dopamine → Midbrain
- Mesolimbic dompaminergic pathway

Neurotransmitter Chart

NEURO-TRANSMITTER	AMINO-ACID ITS MADE FROM	WHAT IT DOES	DEFICIENCY SYMPTOMS
Adrenaline, Noradrenaline	L-phenylalanine L-tyrosine	Arousal, energy, stimulation, mental focus	Lack of energy, depression, poor concentration
Dopamine	L-phenylalanine L-tyrosine	Good feelings, satisfaction, comfort, alterness	Emptiness, lack of pleasure and reward, fatigue, depression, lack of motivation, over-eating
Endorphins, Enkephalines	D-phenylalanine, DL-phenylalanine	Physical and emotional pain relief, pleasure, good feelings, euphoria, sense of wellbeing	Hypersensitivity to pain, inability to feel pleasure, sense of incompleteness craving of pleasure, feeling down
Serotonin	L-tryptophan or 5-HTP	Emotional stability, self-confidence, pain tolerance, quality of sleep	Depression, worry, obsessiveness, compulsiveness, low self-esteem, sleep problems, craving sweets, irritability, fearfulness, tantrums, violence, sexual promiscuity
GABA	GABA, L-glutamine	Calming, relaxation	Anxiety, panic, tenseness, insecurity, sleeplessness, seizures

Barbiturates sedative are agonists

Yoga for Brain Health


THE STRUCTURES OF NEUROTRANSMITTERS
STRUCTURE KEY: Carbon atom Hydrogen atom Oxygen atom Nitrogen atom Rest of molecule
ADRENALINE
Fight or flight neurotransmitter
Produced in stressful or exciting situations. Increases heart rate & blood flow, leading to a physical boost & heightened awareness.
NORADRENALINE
Concentration neurotransmitter
Affects attention & responding actions in the brain, & involved in fight or flight response. Contracts blood vessels, increasing blood flow.
DOPAMINE
Pleasure neurotransmitter
Feelings of pleasure, and also addiction, movement, and motivation. People repeat behaviours that lead to dopamine release.
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Mood neurotransmitter
Contributes to well-being & happiness; helps sleep cycle & digestive system regulation. Affected by exercise & light exposure.
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Calming neurotransmitter
Calms firing nerves in CNS. High levels improve focus; low levels cause anxiety. Also contributes to motor control & vision.
ACETYLCHOLINE
Learning neurotransmitter
Involved in thought, learning, & memory. Activates muscle action in the body. Also associated with attention and awakening.
GLUTAMATE
Memory neurotransmitter
Most common brain neurotransmitter. Involved in learning & memory, regulates development & creation of nerve contacts.
ENDORPHINS
Euphoria neurotransmitters
Released during exercise, excitement, & sex, producing well-being & euphoria, reducing pain. Biologically active section shown.
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if the name of a NT is being use as ana adjective:
use the stem + -ergic

ie: Nuerons that contain ACE are cholinergic
Nicotine is cholinergic → agonist to ACE

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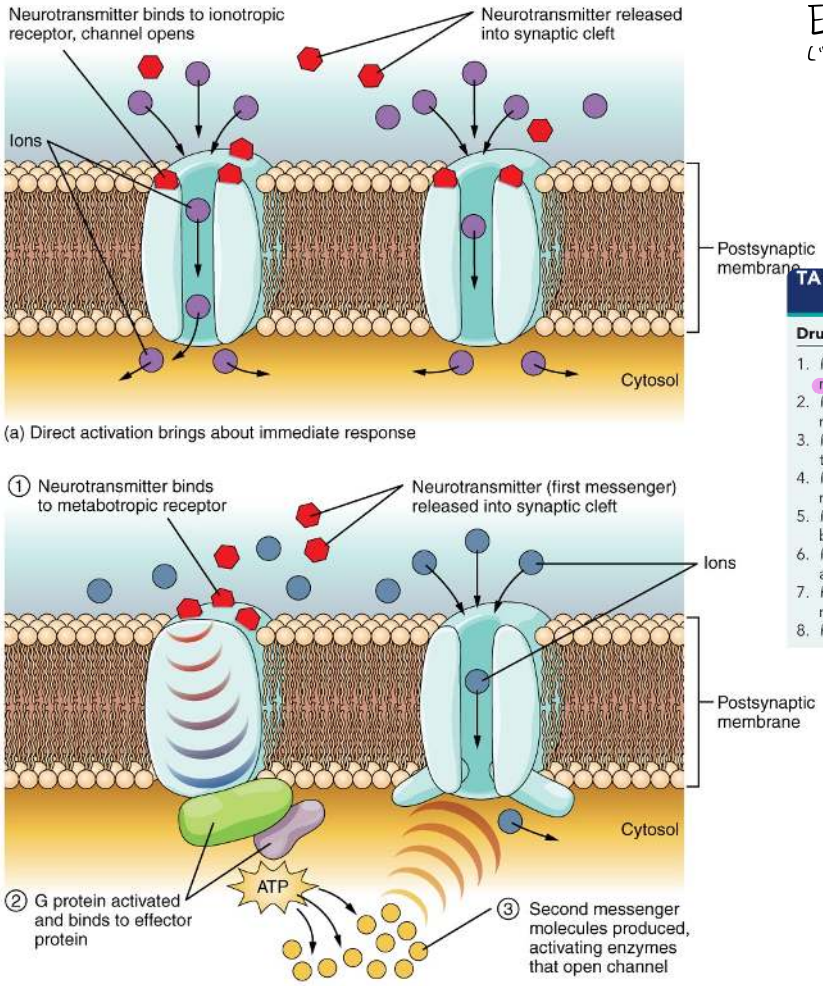
Glutamate
- Agonist: Aspartic Acid
- Antagonist: Ketamine
- Excitory amino acid NT

Anandimide mimicked by Marijuana

Endorphins
- Naturally occuring morphine
- modulate pain relief


Neurotransmitter binds to ionotropic receptor, channel opens
Neurotransmitter released into synaptic cleft
Ions
Postsynaptic membrane
Cytosol
(a) Direct activation brings about immediate response
1 Neurotransmitter binds to metabotropic receptor
Neurotransmitter (first messenger) released into synaptic cleft
Ions
Postsynaptic membrane
Cytosol
ATP
2 G protein activated and binds to effector protein
3 Second messenger molecules produced, activating enzymes that open channel
(b) Indirect activation involves a prolonged response, amplified over time

Enzyme breakdown
("ase")
↳ interact w/ molecule + change its structure so that it is no longer capable of occupying receptor sites

TABLE 3.1 Neurochemical Mechanisms of Drug Action

Drug effects can be produced by altering the following neurochemical systems:

1. *Neurotransmitter synthesis.* A drug may increase or decrease the synthesis of neurotransmitters.
2. *Neurotransmitter transport.* A drug may interfere with the transport of neurotransmitter molecules to the axon terminals.
3. *Neurotransmitter storage.* A drug may interfere with the storage of neurotransmitters in the vesicles of the axon terminal.
4. *Neurotransmitter release.* A drug may cause the axon terminals to release neurotransmitter molecules into the synapse prematurely.
5. *Neurotransmitter degradation.* A drug may influence the breakdown of neurotransmitters by enzymes.
6. *Neurotransmitter reuptake.* A drug may block the reuptake of neurotransmitters into the axon terminals.
7. *Receptor activation.* A drug may activate a receptor site by mimicking a neurotransmitter.
8. *Receptor blocking.* A drug may cause a receptor to become inactive by blocking it.

Synthesis
Storage
Blocking
Activation
Release
Transport
Degradation

Drug affects can be produced by.. SSBARTD

NT are taken back into the terminal button after they have been released.

economical mechanism of deactivating transmitters because the NT molecule is preserved intact and can be used again without the expense of energy involved in the manufacture of new transmitters

Some drugs (ie: cocaine)

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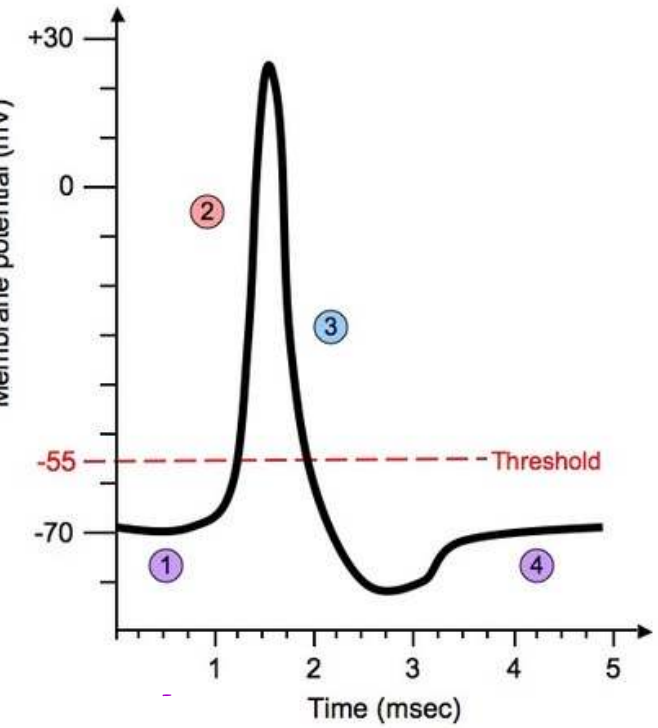

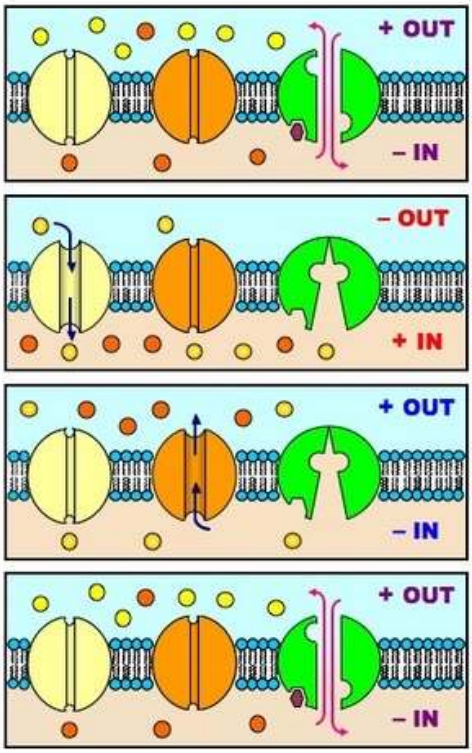

1 Resting Potential
Na^+/K^+ pump

2 Depolarisation
Voltage-gated Na^+ channel

3 Repolarisation
Voltage-gated K^+ channel

4 Resting Potential
Na^+/K^+ pump

The Axon transmitts info by conducting an electrical signal from one end → to the other

[Action potential
electrical impulse along the axon that occurs when a Nueron fires]

↳ AP is produced by the flow of charged particles (ions) through channels in the axon's membrane

① Resting Potential
- concentration of positively charged sodium ions is greater outside the membrane
- - Potassium highest inside Nueron
- Resting state: Negative

Nueron is stimulate

(Action potential) Depolorization

② When the channel opens and responds, positive ions rush in
- If positive charge is stimulated enough it reaches a threse hold
- Even more channels open with more Sodium flowing in

→ "All or Nothing" the axon is either firing with the full voltage or at rest

③ The signal travels down the axon increasing the concentration of voltage gauge handles
potassium flows out of cell + the net charge shifts to negative and the cell its resting potential

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